ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

Review on Effect of Supplementation with Iron-Rich Products to combat Anemia among Adolescent Girls

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ABSTRACT

Nutritional deficiencies are linked to a variety of health issues. Insufficient healthy red blood cells or hemoglobin may lead to an illness known as anemia. Hemoglobin is the primary blood protein responsible for transporting O2 to body cells. Heavy blood loss, persistent chronic disorders, and inadequate nutrition are the primary contributors to anemia. Many teenage girls cannot get enough iron from their diets to meet their high physiological needs for developing body tissues, making more RBCs, and starting menstruation. Anemia due to nutritional inadequacy is mostly caused by a lack of iron, vitamin B12, and vitamin C. Supplementation is recommended as a treatment for anemia caused by iron deficiency. Even though iron from herbal sources is less readily absorbed than inorganic or organic derivatives of iron produced by chemical synthesis, dietary supplements containing iron from herbal sources are still widely used, especially among people who are attracted to the idea of "getting back to nature." The main aim of this review is to see the effect of supplementation (Gogu plants, Curry leaves, Pearl millets, *Moringa Oleifera*) with iron-rich products to combat anemia among adolescent girls.

Keywords: Adolescent, Anemia, Diet, Green leafy vegetables and Iron.

1. INTRODUCTION

It is well recognized that anemia is a major nutritional issue that affects individuals in both developed and developing nations and has negative economic effects on the progress of those countries. Iron deficiency is the primary cause of anemia worldwide, and the terms iron deficiency anemia and anemia are often used interchangeably. Anemia is a condition that affects the entire body and is characterized by a decrease in the volume of red blood cells or a reduction in the concentration of hemoglobin (Hb) in the blood. It can be caused by a lack of micronutrients like iron, folic acid, and vitamin B12, as well as by malaria, hookworm infections, and blood loss from long-term conditions like tuberculosis, intestinal disorders, menstruation, and childbirth. Although it may happen at any stage of life, it is more common in

Adolescent girls and pregnant women. Anemia affects about 47.7% of young children worldwide, 25.4% of school-age children worldwide, and an estimated 41.8% of pregnant women worldwide

ISSN PRINT 2319 1775 Online 2320 7876

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[1]. A lack of iron intake, problems absorbing iron from food, and increased iron needs, particularly during development and pregnancy, are the primary risk factors for iron deficiency anemia.

According to the WHO, adolescence is the age range between adulthood and childhood, or between 10 and 19 years of age. The Latin word "AD- OLESCERE," which means "TO GROW" or "TO MATURE," is where the word "adolescence" originates [2]. The adolescent years are seen as a pivotal time for females as they evolve from young women to mature adults. Adolescence occurs between the stages of childhood and maturity. Approximately 1.2 billion people (all over the globe) fall into the teenage bracket. There is widespread agreement that aiding youth, especially girls, may hasten efforts to reduce poverty, inequality, and discrimination based on gender. Adolescence is a pivotal time in development since it is characterized by profound changes in the individual's brain, personality, and actions. Around 22% of India's total population belongs to this subgroup [3]. The concept of "adolescence" is an ever-evolving theoretical construction that draws on physiological, psychological, temporal, and cultural perspectives. The years between the beginning of puberty and the beginning of adulthood are often considered to be this crucial developmental phase [4].

In girls, the pubertal growth spurt typically occurs between the ages of 10 and 15, coinciding with the period when their iron needs are at their highest physiologically. Sexual maturation, the commencement of menarche, and increased erythropoiesis are just a few of the additional physiological changes that occur in conjunction with puberty in females, and all have significant effects on their iron needs. Adolescents need extra iron after their growth surge ends to replenish depleted tissue zinc pools and low body iron reserves [5]. The significant iron needs thatteenagers' bodies have throughout puberty are often not met. They often consume low-quality foods. It has been hypothesized that this is due to insufficient calorie intake and bad food choice habits stemming from worries about one's weight and, maybe, a lack of physical activity.

In addition, there has been a rise in the popularity of vegetarian diets among people of this age, which often entails a low intake of animal products and greater consumption of plant-based meals. Many plant-based meals are rich in dietary fiber, and polyphenols, whereas meat, and other animal products are excellent suppliers of the mineral iron. Foods containing these substances are known to prevent the body from properly absorbing iron. Unfortunately, this means that teenage females' iron intakes are generally inadequate [6]. Inadequate iron intake may be exacerbated by factors other than food, including heavy menstrual losses, other types of blood loss (such as nose bleeds), and strenuous physical activity [7]. According to UNICEF research from 2012, over a quarter of teenage females were underweight in 11 out of 64 nations, while over a third of adolescent girls were anemic in 21 out of 41 countries. Adolescent girls' malnutrition is linked to the cycle of poverty that passes from mothers to their offspring [8].

Some people may have negative side effects from using conventional iron supplements. This highlights the need for research into the development of innovative products that improve iron bioavailability, stability, and affordability. Natural functional compounds should be a primary focus of study in this area (e.g., lactoferrin, plant ferritin, and heme iron). Excess iron consumption may have negative consequences, including a slowing of the bone metabolism and an increased risk of infection, thus caution should be used when combining these iron-rich substances into food items. Therefore, many iron-fortified meals don't contain an excessive amount of iron.

In terms of safety and value, iron-fortified meals rank among the best options. Cereal, dairy products, and herbal products are all examples of foods that may include Fe or iron-carrying functional components that both transport and aid Fe absorption [9]. In providing food, housing, clothing, and medicine, plants play a crucial role in human survival. They are also the foundation for alternative medical practices that date back hundreds of years, such as Ayurveda, Chinese medicine, Unani medicine, and others. To meet their most fundamental health care needs, many people in underdeveloped nations continue to rely on medicinal plants. In recent years, people all over the

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

world have been interested in traditional alternative medicines due to their widespread availability, cheap cost, and absence of severe side effects. For example, the Moringa tree, Curry leaves, Pearl millets, and Gogu plant has a major role in adolescent girls suffering from anemia.

These plants can be used as a supplement in the diet. Iron deficiency in adolescent girls is a common problem. The edible leaf can be used in treating calcium, vitamin deficiencies, and anemia. Supplementary nutrients such as iron-rich iron to cereals like wheat and maize flours can be added to the diet [10]. Roselle is often mentioned as a remedy for anemia due to its high iron and ascorbic acid content. Ascorbic acid may have an antianemic effect because it increases the body's absorption of nonheme iron in people with anemia [11].

2. MORINGA OLEIFERA

Figure 1. *Moringa Oleifera*

The moringa tree, also known as *Moringa Oleifera*, is a useful medicinal plant and edible food crop. The moringa leaf contains a wide range of macro and micronutrients, as well as active substances including antioxidants. Vital nutrients can be found in moringa leaves, including iron 28.2 mg (25 times more than spinach) and more absorbable into the blood, vitamin A 16.3 mg, calcium 2003.0 mg, vitamin E 113.00 mg, protein 27.1 grams, vitamin C 220.00 mg, and vitamin B 113.00 mg (riboflavin 20.5 mg, thiamine 2.6 mg, nicotinic acid 8.2 mg). The amount of iron in 100 grams of moringa is 28.2 milligrams. Meanwhile, the content of the dried leaves is 25 times greater than that of spinach, 3 times higher than that of almonds, and 1.77 times more absorbable into the blood than that of almonds [12].

Blood hemoglobin (Hb) levels can be raised by ingesting Moringa leaf extract. It has been found that moringa leaf extract helps adolescent females with anemia [13]. The elevated demand for iron in the body causes an increase in iron absorption when anemia is present. Iron and vitamin C included in Moringa leaf extract has been shown to improve iron absorption, and this is the case following their administration.

The leaves, whether eaten raw, cooked, or dried, are revered as a potent nutritional powerhouse. According to Fuglie (2005), a serving of dried *Moringa Oleifera* leaf powder provides 14% of a kid's daily protein, 40% of calcium, 23% of iron, and virtually all the vitamin A a child requires in a day [14]. Over a third of a woman's daily calcium requirement, along with significant amounts of iron, protein, copper, sulfur, and B vitamins, might be supplied by just 100 grams of leaves.

Table 1. Effects of *Moringa Oleifera* in anemia

Author's Name	Study and aim	Result	Conclusion
Anisa *et al*., (2019) [15]	The purpose of this study was to evaluate the efficacy of a combination of vitamin C (50 mg x 2 / day) and Moringa leaf (250 mg x 2 /	In the treatment group, the average hemoglobin level rose from 9.37 to 12.10 gm/dl. By using statistical analysis, researchers were able to confirm that a combination of Moringa leaf and vitamin C was effective in raising hemoglobin levelsin young women with anemia.	It is recommended that young women be made more aware of anemia and its revention andtreatment options.

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	day) in reducing anemia in youngwomen.		
Suzana *et al.*, (2017) [16]	This research examined the potential of an iron- rich extract from *Moringa Oleifera* leaves as a supplement for those struggling with anemia**.**	The averages of the control groups' hemoglobin (0.644±0.83 g/dL), erythrocytes (0.475±0.523) Tpt/L, hematocrit (2.189±4.08%), mean corpuscular volume (4.756±0.89 fL), mean corpuscular hemoglobin (2.183-2.47 pg), and relative dissipation rate (2.844±2.80%) were all significantly higher than the experimental groups. Experimental values were considerably higher for hematocrit (3.14±1.47%), MCH (3.495±1.33 pg), and MCHC (3.264±0.96 g/dL), and significantly lower for platelets count compared to the control group ($p<0.05$).	Researchers conclude that extract from moringa leaves has the potential to treat iron deficient anemiain females.
Tirtawati *et al.*, (2021) [17]	The goal of the study was to find out how *Moringa Oleifera* teabags affect the amount of Hemoglobin (Hb) in teenage girls.	Before treatment, the mean rise in hemoglobin (Hb) was 10.71 g/dl. It raised dropped to 11.03 g/dl 15 days into the treatment. After 30 days of treatment, the average Hb value was 11.63 g/dl, and the p- value was 0.000 ($p <0.05$), indicating a statistically significant difference in Hb levels between baseline and post-treatment.	Adolescent females' hemoglobin levels increased significantly after drinking teamade from Moringa leaves,suggesting that this treatment had an effect.
Devillya et al., (2017) [18]	The study's goal was to determine whether adolescent females with anemia can benefit fromeating *Moringa Oleifera*cookies.	The findings revealed that most respondents (64.5%) were between the ages of 10 and 13 years, most respondents (91.9%) had normal nutritional status, and the mean hemoglobin levels before and after the intervention were 11.13 ±0.81 and 12.67 ±1.08, respectively. *Moringa Oleifera* cookies influenced female teenage Hb, according to the study ($p<0.05$).	*It can be Established that Moringa leifera* cookieshave an impacton anemicfemale adolescents
Sarkar *et al.*, (2021) [19]	In this investigation, moringa leaves were analyzed for their potential as a non-haem iron supplementto treat anemia.	The post-test mean Hb levels for the group using drumstick leaves powder increased from 10.7167±0.25 to 11.1000±0.32 gm/dl, revealing a statistically significant increase ($p <0.001$).	Researchers observed that giving teenage females a powder made from drumstick leaves increasedtheir hemoglobin levels.

3. GOGUS PLANT (*HIBISCUS SABDARIFFA L.*)

Figure 2. *Hibiscus sabdariffa L.*

Anemia is defined as a hemoglobin concentration of less than 11.0 g/dl when measured at sea level. In all age categories, it is the main contributor to morbidity. About 1.62 billion individuals around the world suffered from anemia in 2005. A staggering 67.6 percent of all affected people are in Africa [20]. The flower roselle, or *Hibiscus sabdariffa L.*, is cultivated all over the world. It is a member of the Malvaceae family. With its high concentration of phytochemicals such as polyphenols, notably anthocyanins, polysaccharides, and organic acids, this plant has greatpotential in contemporary medicinal applications and is widely utilized in traditional medicine.

Roselle flower extract was tested on pregnant anemic women using iron supplements in aseparate trial. The study found that the combination of the Roselle extract and iron pills considerably increased hemoglobin levels. This may be because of the greater ascorbic acid content of the Roselle [21].

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Table 2. Role of *Hibiscus sabdariffa L.* in anemia

Author's Name	Study and Aim	Result	Conclusion
Handayani *et al.*, (2022) [22]	The purpose of this study was to demonstrate that supplementation with an extract of the calyx from the Rosella (*Hibiscus sabdariffa Linn.*) plant effectively raises hemoglobin and hematocrit levels in female adolescents with anemia.	The researchers found statistically significant differences between the levels of hemoglobin and hematocrit in the intervention and control groups of female teenagers(p-value < 0.05).	Anemic female teenagers responded well to the combination of Rosella (*Hibiscus sabdariffa* Linn.) calyx extract and Fe+2 tablet.
Peter *et al.*, (2017) [23]	The goal of this research was to determine the effectiveness and safety of an aqueous extract of *H. sabdariffa L.* in treating anemia in adults.	Adults with anemia in a malaria-endemic area did not benefit from using a standardized aqueous extract of *H. sabdariffa L.* (P0>0.005). But *H. sabdariffa L.* extract, due to its high iron and organic acid content, has been shown to have the ability to enhance hematopoietic parameters.	Therefore, larger sample size studies are required to determine the effectiveness of the extract in combination with malaria hemoprophylaxis inmalaria-endemic regions.
Emelike *et al.*, (2013) [24]	Some hematological parameters were investigated when Wistar albino rats were orally administered *Hibiscus sabdariffa* aqueousextract.	The rats' body Weight decreased overall, except for Group A (the control)and Group E. When compared to Group A (the control), all the groups' hematological parameters—including hemoglobin (Hb), packed cell volume (PCV), total white blood cells (WBC), and differentials—increased considerably	According to the research, administering an aqueous extract of *Hibiscus sabdariffa* may have positive effects on the hematopoieticsystem.
		(p< 0.05),and dose- dependently.	
Chukwu *et al.*, 2018) [25]	The purpose of this research was to evaluate and examine hematological parameters using a different preparation of Roselle beverages made from Gogu plant.	Haemoglobin, packed cell volume, platelets, and red blood cell count was found to have greatly increased in Wistar albino rats, whereas lymphocytes and WBC count were found to have significantly reduced. Researchers found that Roselle beverages had hematocrit characteristics and might be utilized to treat anemic people.	Researchers found that Roselle beverages had hematocrit characteristics and might be utilized to treatanemic people.

4. Curry leaves (*Moenigii Murraya)*

Figure 3. Curry leaves (*Moenigii Murraya)*

The most typical cause of anemia is insufficient iron in the diet. The iron and folic acid included in curry leaves make them a potent tool for boosting the body's supply of red blood cells. Absorption of iron from food sources is often aided by eating foods high in folic acid. This isalso taken care of by the abundant folic acid found in curry leaves. As a bonus, curry leaves are an effective blood purifier.

Moenigii Murraya Linn. Spreng (M. koenigii), a member of the Rutaceae family and often referred to as "Curry Patta," is a fragrant plant that has been extensively utilized as an Ayurvedic herbal remedy in India [26]. It has been used for centuries to cure a variety of unrelated conditions, such as anemia, microbial growth, iron supplement, and dysentery.

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Table 3. Benefits of Curry leaves in anemia

Author's Name	Study and Aim	Result and Conclusion	Conclusion
Choudhury *et al.*, (2015) [27]	The goal of this research was to determine whether an aqueous extract of *Murraya koenigii* leaves might affect the levels of specific lipids in the serum of rats.	When comparing the experimental groups with the control group, the results showed that the extract significantly increased (P< 0.05) packed cell volume, hemoglobin concentration, red blood cell, mean corpuscular hemoglobin, mean corpuscular volume, and decreased platelet count. The number of white blood cells in the body was found to be considerably higher after administration of the extract across the board (P< 0.05) compared to the control. As expected, the results demonstrated a rise in thyronine and thyroxine and a reduction in thyroid stimulating hormone at the higher dosage. Testosterone levels were found to be considerably lower (P < 0.05) compared to the baseline value. Total blood cholesterol and low-density lipoprotein cholesterol were both considerably decreased (P< 0.05) by the extract, but high-density lipoprotein cholesterol was not significantly altered.	A positive impact on serum cholesterol levels, stimulation of thyroid functions, treatment of anemia and immunity-dependent illnesses, and strong contraceptive properties were all suggested by this research.

5. PEARL MILLETS (*PENNISETUM GLAUCUM*)

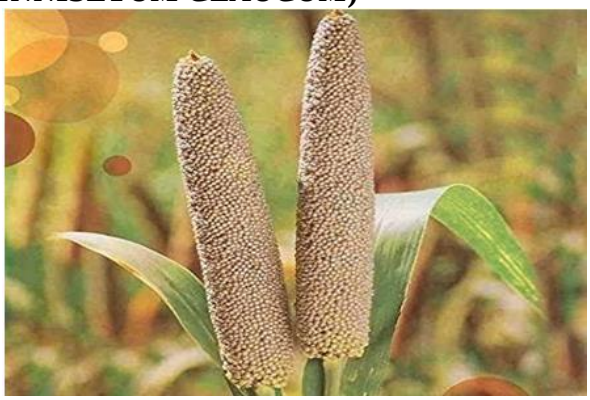

Figure 4. Pearl Millet (*Pennisetum glaucum*)

Iron deficiency is the most common nutritional deficit in the world, and iron deficiency anemia is the major cause of impairment in young children and teenagers. Anemia and iron deficiency are especially common among adolescents.

Many millions of people in the Indian states of Rajasthan, Gujarat, and Uttar Pradesh rely on pearl millet as a major source of nutrition [28]. Children's anemia rates are shockingly high in some areas, at 66%. The high rate of pearl millet eating in these areas suggests a considerable opportunity to increase dietary iron intake. In comparison to other grains, pearl millet has the greatest concentration of iron [29]. It is also an excellent source of calcium, fiber, phytochemicals, and other minerals.

Table 4. The beneficial role of Pearl millet in anemia

Author'sName	Study and Aim	Result	Conclusion
Scott *et al.*, (2018) [30]	Examine the effects of pearl millet with additional iron on the focus and memory retention of Indian school-aged adolescents.	Those who consumed biofortified pearl millet had a greater daily iron consumption than those who consumed standard pearl millet (19.6 mg/d vs. 4.8 mg/d). Biofortified pearl millet was more effective than regular pearl millet in enhancing iron status, as shown by its effects on BI (Body Iron), ferritin, and TfR (transferrin receptor) after 4 months, and on TfR at 6 months (P< 0.05). When compared to regular pearl millet, biofortified pearl millet led to more noticeable gains in memory (CFE (Composite Face Effect task) and CRT (Cued Recognition Task)) and focus[Go/No-Go (GNG) task, SRT	Adolescents in India with low iron levels might benefit from eating iron-biofortified pearlmillet.

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		(simple reaction time), and ANT (Attentional Network Task)].	
Cercamondi*et al*., (2013) [31]	Iron absorption research was performed on 20 Beninese women with low iron levels to see whether iron-	Results indicated that iron- biofortified millet would be highly beneficial in avoiding iron deficiency in millet-consuming communities, even though the fractional absorption of iron	In conclusion, our research indicates that iron biofortified and post-harvest iron-fortified pearl millet absorbs
	biofortified millet may offer more bioavailable iron than ordinary millet or post-harvest iron-fortified millet	From biofortification is lower than that from fortification.	around 2 and 3 times more iron than regular-iron pearl millet.
Singh *et al*., (2014) [32]	The purpose of the current investigationwas to create and standardize an iron-rich ladoo made from pearl millet and to compare the effects of this product to those of Iron Folic Acid tablets in the treatment ofanemia.	Hb levels increased by 2.24 g/dl, 2.28 g/dl, and 0.54 g/dl, respectively, after theintervention program wasimplemented in Groups A, B, and C, respectively. In conclusion, a food-based strategy using pearl millet ladoo may be equally successful as elementaliron supplementation in raising teenage females' hemoglobin levels.	In conclusion, a food-based strategy using pearl millet ladoo may be equally successful as elemental iron supplementation in raising teenage females' hemoglobinlevels.
Devulapalli *et al*., (2022)[33]	To determine the nutritional effects of millet-based meals on weight, body mass index (BMI), hemoglobin, energy bars, finger millet cutlets, and biscuits before and after the intervention.	Blood hemoglobin levels inteenagers ranged from 7.0 to 9.9 g/dl, making more than 90% of them anemic. The average body mass index (BMI) rose from 16.42.5kg/m^2 to 17.32.2 kg/m^2, and the average hemoglobin rose from 8.400.9 g/dl to 8.450.6 g/dl after the intervention. Statistically significant differences in body mass index (p=0.001) and weight (p=0.001) between baseline and post- intervention, at 95% CI, were found using the paired t-test. To combat the prevalence of anemia among school-aged female students, four different types of millet-based ready-to-eat snacks were served as a supplement to the Mid-Day Meal (MDM).	To combat the prevalence of anemia among school-aged female students, four different types of millet-based ready- to-eat snacks wereserved as asupplement to the Mid-Day Meal (MDM).
Jani *et al*., (2015) [34]	In this cross-sectional research, 224 tribal Indian adolescent females were evaluated for folate insufficiency prevalence and adequatefolate consumption (10 to 17	The average folate consumption was 159.5± 44.7 micrograms per day, whereas the average hemoglobin level was125.4±13.0 grams per liter. The geometric mean RBC folate content was 360.2 (329.7 to 393.6) nmol/L. 67%of teenage	Adolescents ofindigenous tribes often lacked the nutrient folate. The demand for culturally competent improvement solutions is pressing.
	years of age).	females had inadequate levels of RBC folate (340 nmol/L), compared to almost half of boys and girls ages 10–12 and 13–15 years. Girls had a lower mean ± SD folate consumption (g/day, 139.4 ± 34.5) compared to males (173.8± 45.2) (p .001). Females between the ages of 13 and 15 had significantly lower folate intakes than girls between the ages of 16 and 17 (78.5% vs 38.6%, p< 0.001) and 100.0% vs 76.9%, p = 0.04. (RDA). There was no correlation between RBCfolate insufficiency and either anemia or folate consumption.	

ISSN PRINT 2319 1775 Online 2320 7876

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DISCUSSION

Most adolescent girls and women of reproductive age (14-45years) are affected by anemia, which is the most prevalent nutritional condition globally. The most typical dietary issue is iron insufficiency. According to WHO data, nutritional deficiency anemia affects 52% of Indian women. Poor eating practices and junk food intake cause anemia. People are consuming junk food more often because of changing their diet and lifestyle habits. Anemia may have a serious negative impact on a person's health and well-being. Diet should include foods that are nutrient- iron-rich. Iron is required for normal bodily function and may be obtained through a variety of foods, including red meat, tofu, salmon, eggs, cereals, and greeny vegetables (Gogu plants, curry leaves, pearl millets, *Moringa Oleifera*).

Various legumes and nuts are great sources of vitamin content. A lot of vitamin C may be found in citrus fruits. These foods should be included in the diet in place of unhealthy alternatives. Anemia is a disease process, not a disease itself. If this process can be stopped, then many deadly diseases won't be able to destroy the body. So many health problems can be avoided if the hemoglobin level in the blood is maintained. adolescent girls who are the future of a country, are especially affected by nutritional deficiencies.

The studies have revealed that teenage females did not obtain enough of the green leafy vegetables (Gogu plants, Curry leaves, Pearl millets, *Moringa Oleifera*) that are recommended for their diets. Accordingly, Curry leaves were consumed at a lower rate than Pearl millet, Gogu plant, and *Moringa Oleifera* [35]. Only limited studies are present on curry leaves. For further fair research more studies are needed to know the exact machinery of curry leaves on anemia. In comparison to other grains, pearl millet has the greatest iron content. It is also an excellent source of calcium, fiber, phytochemicals, and other minerals. The high rate of pearl millet intake indicates a considerable need for dietary iron supplementation. This factor may be utilized in the future to shed light on the herb's emerging applications and value additions, including its potential therapeutic and medicinal characteristics and advances in the fields of processing, extraction, and related health advantages [36]. To increase the plant's usage in a variety of culinary applications, researchers are continuously looking into its nutraceutical characteristics.

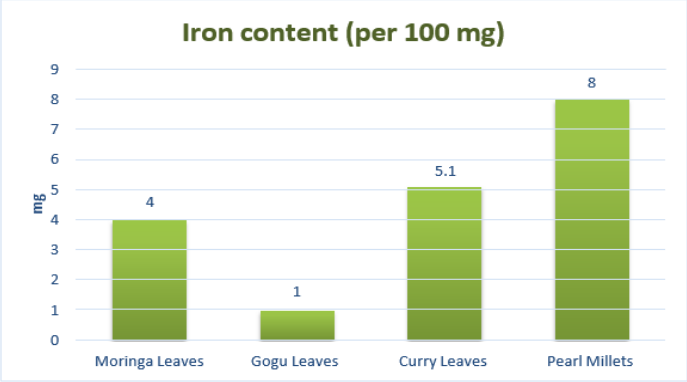

Figure 5. Iron uptake in different plants

The above figure 5 denotes the iron content present in all the plants studied in this review. It can be seen from the figure that the iron content is maximum in Pearl millet > Curry leaves > *Moringa Oleifera* > Gogu plant. We can conclude that higher the iron content in the plant, more it can be helpful in treating iron deficiency.

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However, when fresh fruits, leaves, roots, and seeds are processed into a powder or extract, many of the beneficial bioactive and phytonutrients are lost in the process. Therefore, scientists and businesses are constantly developing new approaches including freeze-drying, ultrasound- assisted and microwave dehydration, vacuum dehydration, etc., to reduce the likelihood of such losses occurring.

CONCLUSION

A few of the barriers to taking iron supplements that were discovered include a lack of knowledge and awareness of anemia and its effects among women, and adolescent girls, problematic supply and distribution systems for iron supplements, and misconceptions about the harmful physiological effects of iron supplements (such as the cause of hypertension disease), other cultural beliefs, poor access, and infrequent and late use of prenatal health services. According to studies on iron supplements, most women saw no negative side effects. Iron supplementation programs won't improve much unless supply and delivery problems are addressed. Demand is another problem since expecting women to adhere to any pattern for an extended period needs complex behavioral abilities. To ensure young girls stick to a daily routine and identify innovative solutions to supply and distribution problems, research is needed in the context of programs.

REFERENCES

1. De Benoist B, Cogswell M, Egli I, McLean E. Worldwide prevalence of anaemia 1993-2005; WHO global database of anaemia.
2. Beard JL. Iron requirements in adolescent females. The Journal of nutrition. 2000 Feb 1;130(2):440S-2S.
3. Russell R, Beard JL, Cousins RJ, Dunn JT, Ferland G, Hambidge K, Lynch S, Penland JG, Ross AC, Stoecker BJ, Suttie JW. Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. A report of the panel on micronutrients, subcommittees on upper reference levels of nutrients and of interpretation and uses of dietary reference intakes, and the standing committee on the scientific evaluation of dietary reference intakes food and nutrition board Institute of medicine. 2001:797.
4. King JC. Does poor zinc nutriture retard skeletal growth and mineralization in adolescents? 1'2. Eur J Clin Nutr. 1994;48:875-9.
5. Gibson RS, Heath AL, Ferguson EL. Risk of suboptimal iron and zinc nutriture among adolescent girls in Australia and New Zealand: causes, consequences, and solutions. Asia Pacific journal of clinical nutrition. 2002 Dec;11:S543-52.
6. Donovan UM, Gibson RS. Iron and zinc status of young women aged 14 to 19 years consuming vegetarian and omnivorous diets. Journal of the American College of Nutrition. 1995 Oct 1;14(5):463-72.
7. Heath AL, Skeaff CM, Williams S, Gibson RS. The role of blood loss and diet in the aetiology of mild iron deficiency in premenopausal adult New Zealand women. Public Health Nutrition. 2001 Apr;4(2):197-206.
8. Unicef. A new era for girls: Taking stock of 25 years of progress.
9. Man Y, Xu T, Adhikari B, Zhou C, Wang Y, Wang B. Iron supplementation and iron- fortified foods: a review. Critical Reviews in Food Science and Nutrition. 2022 Sep 8;62(16):4504-25.
10. Lukaski HC. Magnesium, zinc, and chromium nutriture and physical activity. The American journal of clinical nutrition. 2000 Aug 1;72(2):585S-93S.
11. Peter EL, Rumisha SF, Mashoto KO, Malebo HM. Ethno-medicinal knowledge and plants

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traditionally used to treat anemia in Tanzania: A cross sectional survey. Journal of Ethnopharmacology. 2014 Jul 3;154(3):767-73.

12. Anisa N, Wahyuni S, Rahayu S, Choirunnisa A, Martanti LE. Effect of moringa leaves and vitamin C capsule combinations in increaseing hemoglobin levels of young women with anemia. InProceedings of the International Conference on Applied Science and Health 2019 Aug 25 (No. 4, pp. 565-570).
13. Tirtawati GA, Kusmiyati K, Purwandari A, Donsu A, Korompis M, Wahyuni W, Kuhu F, Keintjem F, Tuju S, Dompas R, Montolalu A. Moringa oleifera Teabags Increase Hemoglobin in Adolescent Females. Open Access Macedonian Journal of Medical Sciences. 2021 Jun 16;9(A):393-6.
14. Fuglie LJ. The Moringa Tree. A local solution to malnutrition http://www. moringa news. org/documents/Nutrition. pdf (http://www. Moringa news. org/documents/Nutrition. pdf)(Accessed: 2 July 2009). 2005.
15. Anisa N, Wahyuni S, Rahayu S, Choirunnisa A, Martanti LE. Effect of moringa leaves and vitamin C capsule combinations in increaseing hemoglobin levels of young women with anemia. InProceedings of the International Conference on Applied Science and Health 2019 Aug 25 (No. 4, pp. 565-570).
16. Suzana D, Suyatna FD, Andrajati R, Sari SP, Mun'im A. Effect of Moringa oleifera leaves extract against hematology and blood biochemical value of patients with iron deficiency anemia. Journal of Young Pharmacists. 2017;9(1s):S79.
17. Tirtawati GA, Kusmiyati K, Purwandari A, Donsu A, Korompis M, Wahyuni W, Kuhu F, Keintjem F, Tuju S, Dompas R, Montolalu A. Moringa oleifera Teabags Increase Hemoglobin in Adolescent Females. Open Access Macedonian Journal of Medical Sciences. 2021 Jun 16;9(A):393-6.
18. Devillya PD, Farissa F. Effect of Moringa oleifera cookies in anemia adolescent.
19. Sarkar A, Vijayamalar S, Sarkar A, Ramu K. A pilot study to assess the effectiveness of drumstick leaves powder supplementation in prevention of anemia among adolescent girls.
20. Adamson JW. The anemia of inflammation/malignancy: mechanisms and management. ASH Education Program Book. 2008;2008(1):159-65.
21. Soejoenoes A, Wahyuni S. Effect of Roselle (hibiscus sabdariffa) on changes in hemoglobin levels in pregnant women with anemia taking iron supplement. Belitung Nursing Journal. 2017 Dec 28;3(6):771-7.
22. Handayani L, Sumarni S, Mulyantoro DK. The Utilization of Rosella (Hibiscus Sabdariffa Linn.) Calyx Extract to Increase Hemoglobin and Hematocrit of Female Adolescents Anemia. JURNAL ILMU KEFARMASIAN INDONESIA. 2022 Apr 29;20(1):107-12.
23. Peter EL, Rumisha SF, Mashoto KO, Minzi OM, Mfinanga S. Efficacy of standardized extract of Hibiscus sabdariffa L.(Malvaceae) in improving iron status of adults in malaria endemic area: A randomized controlled trial. Journal of ethnopharmacology. 2017 Sep 14;209:288-93.
24. Emelike CU, Dapper DV. Effects of oral administration of aqueous extract of Hibiscus sabdariffa on some haematological parameters of Wistar albino rats. IOSR J. Dental Med. Sci. 2013;9:31-4.
25. Chukwu CN, Ikewuchi CC, Akaninwor JO. Comparative investigation of the effects of different aqueous preparations of Hibiscus sabdariffa (Zobo Drinks) on haematological parameters in normal Wistar albino rats. International Blood Research & Reviews, 1À7. 2018.
26. Joshi R, Jat BL, Sharma A, Joshi V, Bohra N, Nandwani D. In vitro determination of antioxidant activity of Murraya koenigii (L.) Spreng. Funct Plant Sci Biotechnol. 2011;5:75-7.
27. Choudhury S, Sinha MP. Effect of aqueous extract of Murraya koenigii on haematological, hormonal and lipid profile of albino rats. J Coastal Life Med. 2015;3:901-05.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

28. Bouis HE, Saltzman A. Improving nutrition through biofortification: a review of evidence from HarvestPlus, 2003 through 2016. Global food security. 2017 Mar 1;12:49- 58.
29. Goyal M, editor. Prospects & dimensions for utilization of arid foods. Yash Publishing House; 2006.
30. Scott SP, Murray-Kolb LE, Wenger MJ, Udipi SA, Ghugre PS, Boy E, Haas JD. Cognitive performance in Indian school-going adolescents is positively affected by consumption of iron-biofortified pearl millet: a 6-month randomized controlled efficacy trial. The Journal of nutrition. 2018 Sep 1;148(9):1462-71.
31. Cercamondi CI, Egli IM, Mitchikpe E, Tossou F, Zeder C, Hounhouigan JD, Hurrell RF. Total iron absorption by young women from iron-biofortified pearl millet composite meals is double that from regular millet meals but less than that from post-harvest iron- fortified millet meals. The Journal of nutrition. 2013 Sep 1;143(9):1376-82.
32. Singh TS, Goyal M, Sheth M. Intervention trials with pearl millet based iron rich laddo and iron folic acid (IFA) tablets on hemoglobin status of adolescent females in Bikaner city. Studies on Ethno-Medicine. 2014 Apr 1;8(1):77-82.
33. Devulapalli D, Gokhale D. Impact of Millet-Based Interventions on Weight, Body Mass Index and Haemoglobin of School-Going Adolescent Girls. Indian Journal of Science and Technology. 2022 May 28;15(20):983-8.
34. Jani R, Salian N, Udipi S, Ghugre P, Lohia N, Haas J, Boy E. Folate status and intake of tribal Indian adolescents aged 10 to 17 years. Food and nutrition bulletin. 2015 Mar;36(1):14-23.
35. Pareek P, Hafiz A. A study on anemia related knowledge among adolescent girls. Int J Nutr Food Sci. 2015;4(3):273.
36. Wang XJ, Ren JL, Zhang AH, Sun H, Yan GL, Han Y, Liu L. Novel applications of mass spectrometry-based metabolomics in herbal medicines and its active ingredients: current evidence. Mass Spectrometry Reviews. 2019 Aug;38(4-5):380-402.